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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This ZIM-SCI study guide is a three-part unit consisting of activities, experiments, and readings on: (1) plant and animal cells; (2) growth and reproduction; and (3) human reproduction. Experiments provided include examining plant and animal cells, preparing models of these cells, and dissecting a rat. Information is also provided throughout the unit to help students understand the scientific principles behind the activities and experiments. Because students may come from traditional homes where various topics in this unit are not discussed (such as human reproduction and family planning), it is suggested that sections containing these topics may be read silently. (JN)

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E1

STUDY GUIDE

Life, Beginning and Growing

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

SE043840

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AUGUST, 1981

Zim - Sci
Zimbabwe Secondary School Science Project

GENERAL SCIENCE

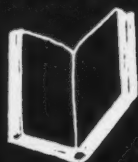
STUDENTS : Please read this carefully. It will help you.

How you will study

This study guide comes to you with a kit of apparatus. Both things are part of a study programme leading you to an understanding of aspects of science. In this course you will be carrying out experiments. The study guide will help you to understand the scientific principles behind the experiments.

Your work should be done as you are instructed, either by the teacher or the study guide.

To help you to see quickly what you must do, the study guide uses these symbols.



for "Read and revise your notes and Study Guide"



for "Take note of an important point that you should learn."



for "Summary". This is to help you to go over what you have learned.



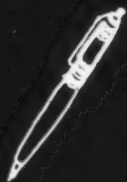
for "Experiment".

When you see this sign,
read the instructions
carefully from beginning
to end before you start
to do the experiment.

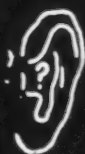


for "How much do you know?"

This is for you, to help
you to test whether you
are remembering what is
important.



for "Written work". This is
when you must answer
questions in writing.



for Listen to the teacher
and do exactly what
the teacher tells you to do

GENERAL SCIENCE

UNIT E1

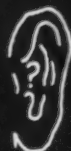
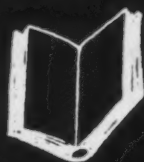
LIFE : BEGINNING & GROWING

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AIMS OF THIS UNIT

When you have completed this study unit you will be able to:

1. Identify an animal cell and a plant cell when seen through the bioviewer.
2. List the differences between animal and plant cells.
3. Recognise different types of animal and plant cells.
4. Draw and label the male and female sex cells of animals.
5. Explain how a new animal is formed by the fusion of two sex cells.
6. Explain why animals of the same kind can be slightly different from each other.
7. Explain how external and internal fertilisation happens.
8. Describe the advantages of internal fertilisation.
9. Draw and label the male and female reproductive organs of a mammal.
10. Describe the growth of an embryo.
11. Describe how a baby is born.
12. List the needs of a new born animal and explain how these needs are satisfied for human and other animals.



As it is some time since you have looked at living things, your teacher will use this period for you to read over and revise Unit A2. At the end of the period he will ask you about the differences in characteristics of various living things.

In this new unit you will find out some more differences.

PART 1

CELLS

You have looked at the outside characteristics of living things - such as colour, shape, size and behaviour. Have you ever wondered what is inside the organisms? You have probably seen a dead animal cut up or a tree chopped into logs, but you may not know how they are made!

Do you remember the wonderful microscope through which you were able to see the tiny pond animals? Until it was invented, scientists did not know what living things were made of. Now you can take thin pieces of living things, look at them under the microscope and biowiewer and discover this for yourself!

We shall start by looking at part of you.

No, you are not going to be cut up! You are only going to examine part of your skin under the microscope.

If you tried to get enough skin from the outside of your body, you would damage yourself as it is quite strong and tough. The skin inside your mouth, however, is soft and easy to obtain without hurting yourself.

EXPERIMENT 1

You will need:

Clean fingers which have been dipped in
meths and shaken dry.

1 microscope slide

1 coverslide

1 pin or mounted needle

water

1 drop of methylene blue stain

Bioviewer

Bioviewer strip J.F.102



Place a drop of water on your slide. Using a clean fingernail scrape the inside of your cheek firmly. You will find a whitish substance comes away. Place this whitish substance in the drop of water by dipping your fingernail up and down.

Take the slide up to your teacher who will add a drop of stain to it. This will make the cheek skin easier for you to see under the microscope.

Finish making the slide by lowering the coverslide with the help of your pin or needle. Your teacher will choose a slide from the class and put it under the microscope for all the pupils to look at.

While you are waiting to view the slide, look at Slide 1 on the Bioviewer strip.

This is a photograph of a slide just like the one you have made. What do you see on it? Discuss with your partner the shape of what you see.



Did you expect to find a big solid lump? Well, you must have been amazed to see some little flat circles with dark patches in the middle. Some of these circles may have been joined together. Your cheek skin is made of little circles joined together! These circles are called CELLS.

Do plants have cells too? Your teacher will give you some plant material to look at.

You will put some on a slide and he will choose one for all the pupils to view under the microscope.

Your teacher will give you a piece of onion skin or bean root. If your teacher has onion pieces for you, follow Chart A. If your teacher has a bean root for you, follow Chart B.

EXPERIMENT 2: To prepare a slide of plant material

CHART A : To make a slide of Onion Skin



An onion is made of tightly packed thick leaves which store food underground. Your teacher will have cut one in half, taken the leaves apart and cut them up. He will give you a small piece.

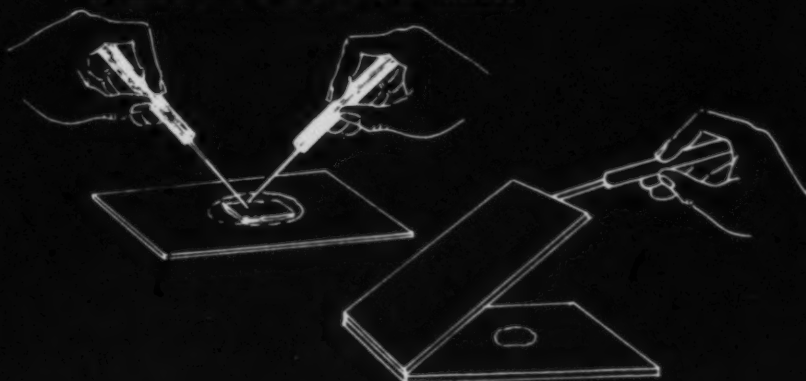
You will need:

- 1 mounted needle
- 1 slide
- 1 coverslide
- water
- spatula
- piece of onion and a drop of iodine stain (from your teacher)

1. Put a drop of water on your slide.
2. Add a drop of iodine stain.
3. On the flat surfaces of your piece there will be a thin skin - like a piece of plastic bag. Peel it off.



4. Place the onion skin into the water on your slide.
5. Spread it out flat with your needle.



6. Lower the coverslide carefully over the skin.

Your slide is ready to view.

EXPERIMENT 2: To prepare a slide of plant material

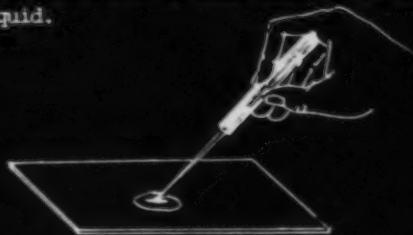
CHART B : To make a slide of a Bean Root

Your teacher will have wet some bean seeds to make them grow and will give you a piece of the new root.

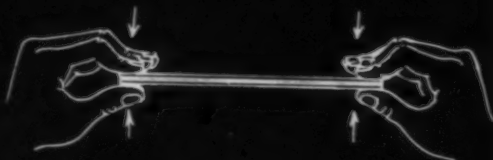
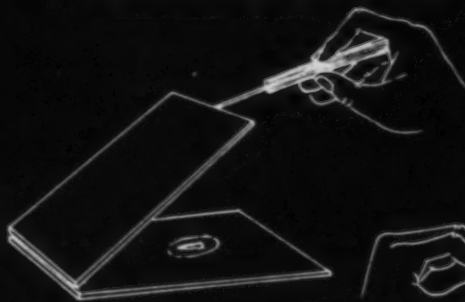
You will need:

- 1 mounted needle
- 2 slides
- water
- spatula
- a piece of bean root and a drop of stain (from your teacher)

1. Have ready a slide with a drop of water in the centre.
2. Add a drop of stain.
3. Place the piece of bean root in the centre of the liquid.



4. Lower one slide onto the other.



5. Gently squeeze the two slides together. Your root should now be flattened out to 4-5 times the width it was before.

Your slide is now ready to view

Your teacher will choose a slide for you to see under the microscope. While you are waiting, look at slide 2 on your bioviewer. This is a piece of onion skin seen under a microscope. What do you see? Discuss it with your partner.

Can you see regular shapes fitted together like bricks in a wall? They are cells too, although they do not look like those from inside your cheek!

You have seen cells from both a plant and a person and you will want to know more about them.
Do Exercise 1.

Exercise 1: Naming the parts of a cell.

Look again at slide 1, which is an animal cell. Draw one of these cells.

1. In the middle of the cell is a thick dark patch. This is called a NUCLEUS. Label it in your drawing. The nucleus contains a set of instructions which tells the cell how to do things.
2. Around the nucleus there is a lighter part, this is the CYTOPLASM. Label it in your drawing. It is made of a soft squashy substance.
3. The whole cell is surrounded by a very thin skin called a MEMBRANE. You can see it around the edge of the cell as a darker line - label it in your drawing. It protects the cell and keeps the cytoplasm in place.

You now know that:

An animal cell has three main parts, they are the _____, the _____ and the _____.

Copy this sentence in your books, filling in the missing words.

The plant cells looked a little different.

Do Exercise 2.

Exercise 2: Naming the parts of a plant cell.

Look at slide No. 2 again, which is plant cells. Draw one plant cell.



1. This cell has a NUCLEUS. Can you find it? It is labelled 'N' on the biostrip. It is not in the centre of the cell, but to one side. Label it in your drawing. It does the same job as the animal cell nucleus.
2. A plant cell also has CYTOPLASM. This does not fill the cell. You will see it around the edges of the cell. It is labelled 'C' on the biostrip. Label it in your drawing.
3. The space where there is no cytoplasm is called a VACUOLE and is filled with a liquid called cell sap. Label a vacuole in your drawing. The sap helps to keep the cell stiff.
4. Around the cell you will see a thicker edge. This is because a plant cell has a stiff box around it called a CELL WALL - label it. This makes it more rigid, more regular in shape than an animal cell. The plant cell does have a membrane as well, but it is too difficult for you to see as it is stuck against the cell wall.

Write down and complete this sentence in your book:

A plant cell has _____, _____ and _____ like an animal cell. It also has a stiff _____ and cell sap in a _____ which help keep it a firm shape.

Now read for yourself about these cells in your bioset notes.

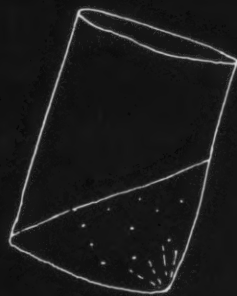
You have seen cells under the microscope and now know that animals and plants are made of cells. You are now going to make a model of a simple animal type of cell. It will not be exactly like a real cell, it will be a model. However, it will help you to remember what a cell consists of and that cells are not all flat as they appear under the microscope.

EXPERIMENT 3: To make a model of a simple animal cell

You will need:

- a plastic bag
- some soft jelly
- some hard jelly
- some thread
- a mounted needle
- your spatula/stirrer
- your beaker
- your boiling tin

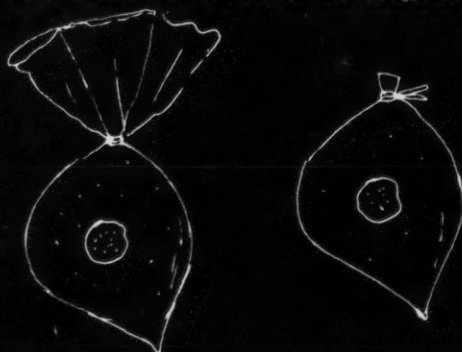
Take your plastic bag and beaker to your teacher. He will give you some soft jelly in the bag. He will give you a small lump of hard jelly in your beaker.



Squeeze all the soft jelly into a corner of the bag.
Push the hard jelly into the middle of the soft jelly.

Squeezing carefully so that no air is left inside, tie the thread around the bag as in the diagram.

10



This is now a model of a simple cell - it is not alive of course. The hard jelly represents the nucleus. The soft jelly represents the cytoplasm. The plastic bag represents the membrane. A living cell would need food, water and air. How would it get them?

You can prick tiny holes all over the model membrane. These represent the 'pores' or gaps in the membrane of a real cell. These pores allow dissolved substances into and out of the cell.

Your teacher will give you a dye solution in your boiling tin. Put the model of the cell into the tin and look at it in the next lesson. You have made a model of a simple animal cell. How do you think you could use it to make a model of a plant cell? Discuss your ideas with your teacher.

Now do Exercise 3.

While you are doing Exercise 3, your teacher will pass around some real cytoplasm and membrane for you to see and feel.



SOME SINGLE CELL ORGANISMS

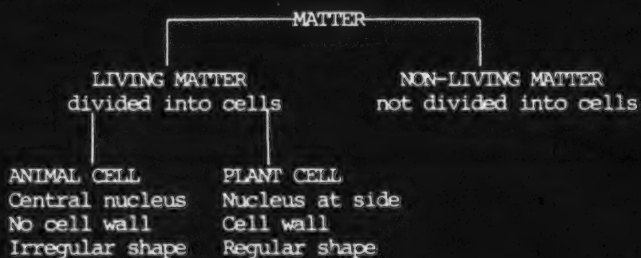
Look at slides 3 and 4 of your biostrip JF.102. These organisms are like those you saw in pond water. They are made of only one cell! Look at them and read about them. Do you think the amoeba looks like the blob of jelly you used in making your model? The amoeba is a single living cell. The important difference between living and non-living things is that living things are organised in cells.

You know that living things behave differently to non-living things, does this mean that they are made up of different substances?

No, living things are also made of chemicals, but the way in which the elements are put together to form the living cells is different.



Here is a summary of all you have learned in this unit so far.



GROUPS OF CELLS



Do you remember on slide 1 (cheek cells) and slide 2 (onion cells) of your slidestrip, you could see where some cells were joined together? When many cells are fitted together like this they form a **TISSUE**. You saw a piece of cheek tissue, and a piece of onion skin tissue.

ARE ALL YOUR CELLS THE SAME?

Look at your partner. Is he the same all over? No - a person has white parts to the eye, a pink tongue, hard fingernails and soft skin. Do you think all your partner's cells are the same?

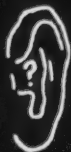
ARE ALL PLANT CELLS THE SAME?

Look at the tree outside. Are the leaves and trunk the same shape and colour? Do you expect the leaf cells and stem cells to be all the same?

Your teacher will discuss this with you.

Your teacher will also cut a very thin slice of a plant stem for you to see under the microscope. You will want to know if your guess about cells is right.

While you are waiting your turn to look, do Experiment 4.



EXPERIMENT 4

You will need:

- your Bioviewer
- slide strip JF.102

Look at slide No. 5. Read about it in your bioset. It is also a slice of plant stem. Are the cells all the same? Discuss the differences you can see with your partner.





You have seen that the cells within the stem of a plant show differences in shape and size. They also seem to have different work to do. What are their jobs? From what you have read in the bioset and your own observations, answer Exercise 4 which your teacher will give you

WHEN CELLS DO SPECIAL JOBS THEY ARE SAID TO BE
'SPECIALIZED' CELLS.

WHY DO CELLS BECOME SPECIALIZED?

You have looked at one celled plants and animals.

In a one celled plant or animal, all the work of living is done by the one cell. This is quite easy as dissolved food and air can pass quickly and easily into such a tiny blob of cytoplasm by diffusion. You saw this kind of thing happening in your cell model.

Imagine you were a big blob of jelly floating in water. Getting dissolved food into your middle would be very slow. However, each part of you needs food and air and water as you are a living thing. You will understand that, as the size of an organism increases, special arrangements have to be made to get food and air right through it.

So many specialized cells are needed by a large organism, such as yourself, and this is why you are made up of different cells grouped together in tissues. You saw groups of special cells in the stem of a plant. One group carried water from the root to the leaves, another group carried food around and the third group did the growing.

It is more efficient for a group of cells to be doing one job only and doing it properly than for all the cells to be trying to do a whole lot of jobs.

Your cheek cells were specialized and formed a tissue of skin. Now look at some more specialized cells from the human body (not your body this time!) on the Biostrip.



EXPERIMENT 5

You will need:

your Bioviewer

Bioset JF.102

Look at cells on slides 6 and 7 and look again at slide 1. You will see four different types of cells. Read about them. Complete Exercise 5 which your teacher will give you

GROUPS OF TISSUES

Have you ever seen a goat, cow, pig or wild animal being cut up for eating? Perhaps you have helped mother cut up or clean out a chicken. You may remember there was a long soft tube, with smelly stuff inside. This tube deals with the animal's food: it is the gut. Did you see two light pink bag-like parts in the chest? These are lungs which are used for breathing. Your grandfather has quite likely eaten the brains from a head of a cow, the tripe which is the stomach, some liver or kidneys. All these different parts do different jobs while the animal is alive. They are called **ORGANS**.

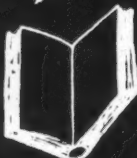


Organs consist of many tissues bound together. You will remember that a tissue is made up of specialized cells.

Specialized cells are built up into organs which do certain jobs in the body.

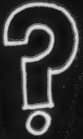
Complete Exercise 6.

At this point you should spend a lesson revising Part 1 of this unit. Then answer 'How much do you know?'



HOW MUCH DO YOU KNOW?

1. ----- are built up of little pieces called cells.
2. A cell has a ----- which contains a set of ----- which tells the cell what to do.
3. A cell has a ----- around it which lets in dissolved substances by -----
4. An animal cell is filled with jelly called -----
5. A plant cell has only a little jelly called ----- but has a large space called a ----- filled with -----
6. A plant cell also has a stiff ----- around it which still allows dissolved substances in.
7. Cells may be different because they have different ----- to do. They are then said to be ----- cells.
8. Similar -----cells are grouped together to form a -----
9. When groups of cells work together as a team to do a certain job, i.e. the heart, they make up an ----- . Other examples are ----- and -----
10. Some very small organisms are only single celled. An example is the -----



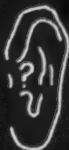
PART 2HOW DO ORGANISMS GROW?

One of the characteristics of living things is their ability to increase in size. How does this happen? More cells must be made. How do they do this? Each cell divides into 2 cells. First, the nucleus grows bigger, making 2 sets of knowledge and life instructions. These two sets then separate, moving away from each other. At the same time the cytoplasm grows. Last of all the cell breaks completely into 2 identical cells. Each new cell formed this way now has its own membrane, cytoplasm and nucleus and is exactly the same as the original cell which made it.

The number of cells is more and so the organism has grown bigger.

Now look at slide 8 on your Biostrip and read the information given.

So every day you are growing bigger in this way. Your cells are dividing to make more new cells as you grow. You know that living things do not continue to grow for ever. They stop growing and later die. How long do different organisms live? Your teacher will discuss this interesting question with you.





When organisms produce more living things like themselves it is called REPRODUCTION.

HOW DOES NEW LIFE BEGIN?

Before you were born you grew inside your mother.

How did you start to grow? You grew from one single cell inside your mother. This single cell was the beginning of you. How was it made? Special cells were needed for this.

There are two kinds of cells which are made specially for beginning a new organism - such as you.

One kind of cell comes from a male organ and is a male cell. The other kind comes from a female organ and is a female cell.



Because there are both male and female cells they are called the SEX CELLS. The organs which produce them are called the SEX ORGANS.

What sort of cells are these sex cells? They are different from all other cells in a very strange way. The nucleus of each contains only a half set of growing instructions! You could not do an experiment properly if you had only half the instructions could you? A male sex cell or a female sex cell cannot, on its own, make a new organism. This is why two cells are needed. If the nucleus of a male cell and the nucleus of a female cell are put together, a complete set of instructions is obtained, and a new organism can grow. All but the simplest of living things start off from two cells in this way.

You are going to look at sex cells now.

EXPERIMENT 6

You will need:

Bioviewer

Biostrip (slide strip from Bioset JG - How animals reproduce)



Look at the first slide. You will see several dots which seem to have a long thread attached. Each one of these is a male sex cell or SPERM. There is one marked with the letters H and T. H stands for head. This is the cell itself, which has a nucleus and a small amount of cytoplasm. Remember this nucleus has only a half set of instructions! T stands for the tail. This tiny sex cell can swim in liquid by moving its tail the way a fish or tadpole does.

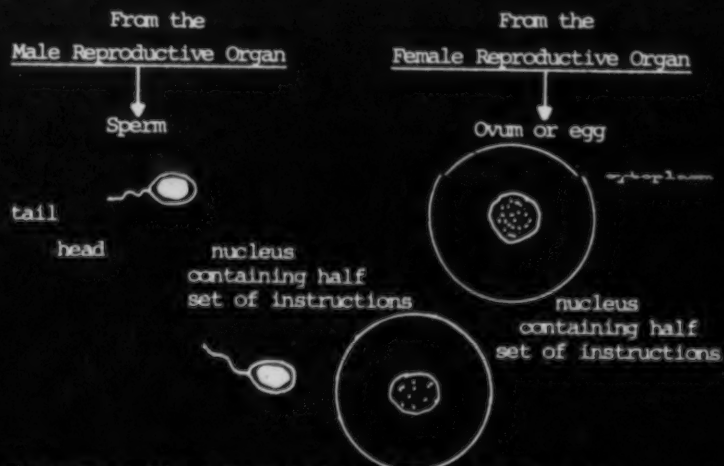


Look at slide 2. In this slide you will see a large round single cell. This is a female sex cell. It is called an OVUM. It contains much more cytoplasm than the sperm does. Look for the nucleus marked N. This contains another half set of instructions.

Can you see two dark spots marked S1 and S2? These are two sperm cells. They have been attracted to the egg cell and have swum to it. The sperm S1 has lost its tail and is moving through the cytoplasm of the egg. The two nuclei from the sperm and egg will join together or FUSE and the egg cell will now have a full set of instructions. As soon as this happens no more sperm can get into the EGG. This new cell can now grow into an animal. It has been FERTILISED.

Now do Exercise 7.





The sperm cell is attracted to ovum and swims to it



The male cell loses its tail and its head moves into the cytoplasm of the egg



The two cells fuse together and form a complete cell with a nucleus containing a whole set of instructions for making a new animal.

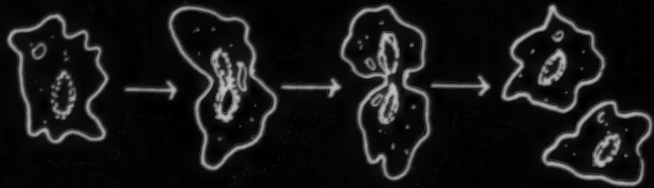
This process is called FERTILIZATION and a new animal can grow from the fertilized egg.

When male sex cells and female sex cells fuse together and grow into a new organism it is called SEXUAL reproduction.



WHY SEXUAL REPRODUCTION?

Some simple organisms can reproduce like the cells you saw on the Biostrip JF. For example, amoeba just divides in two when it is big enough to make two new animals.



Hydra, which you saw on Biostrip JH (slide 7), grows a bud out of its side which breaks off and becomes a new hydra.



Even sugar cane can be grown by taking a piece, sticking it in the ground and watering it. It will become a new sugar cane plant. Can you think of any more plants your parents grow this way?

Most animals, and especially people, are too big and too specialized to reproduce this way. That is why sexual reproduction is needed.

You saw in Unit A2 the variety among people in the distribution of such characteristics as pulse rates and tongue rolling. Even within your own family there are differences in appearances, likes, dislikes, and abilities. This is fortunate as the country needs people to do different jobs, and some people make good farmers, others good nurses, good shopkeepers, and so on. Variety comes about because of the joining up of instructions from two sex cells - a male and a female.

Farmers choose the best varieties to breed better animals and plants, such as cows which produce more milk, hens which lay more eggs or maize plants which produce more food.

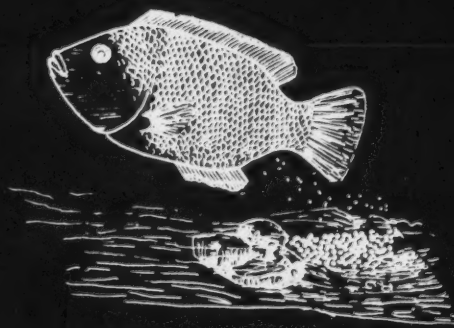
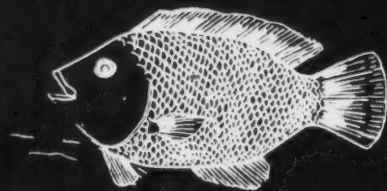
So sexual reproduction is a good way of making new organisms, but how are the two sex cells (sperm and egg) brought together?

WAYS AND MEANS OF BRINGING ABOUT FERTILIZATION

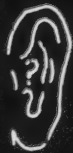
Fertilization needs to take place in liquid. You will understand this as you have seen that a sperm has a tail and must swim to the egg cell.

When an animal lives in water, fertilization is not difficult. Let us see how it happens.

Look at the diagram. It shows the process of fertilization in a bream fish.



When the eggs have been made in the female's body, they pass out of the body through a special tube called the egg tube into the water. The male then releases his sperms from his body through a special sperm tube, leading from the male sex organ. These sperms are released near the eggs, and swim to them. Many more sperms than eggs are produced and the sperms must be released near the eggs. Why do you think this is so? Discuss this with your teacher.



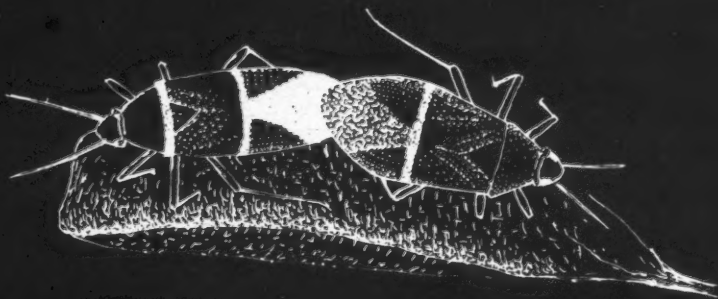
When the fusing of male and female sex cells takes place outside the body of the female, this is called EXTERNAL FERTILIZATION.

Another animal which uses external fertilization is the toad. At a certain time of the year, the female toad (which is the larger animal) becomes swollen up with all the eggs she is making inside. The male grows little hard pads on his front feet. He grasps hold of her for a time, encouraging her to lay the eggs in the water. When she does, he spreads his sperm near them.

Look at the diagram, it shows a toad encouraging the female to lay eggs.



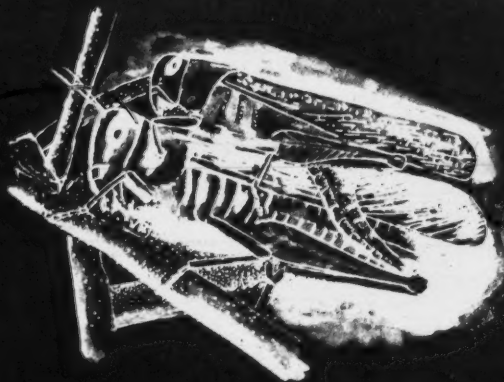
Now, what happens in animals which do not spend any part of their lives in water? A sperm cannot swim in air! A method has to be found to get the eggs and sperm together. Look at the diagrams.



cotton stainer
beetle



melon beetle



locust



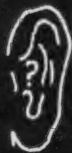
Instead of the female laying eggs to be fertilized externally, she holds them in her body. The male pushes the end of his body into an opening in the female. This opening is the end of the egg tube. His sperms are contained in a liquid which passes down into the egg tube of the female. Now the sperms can swim to the eggs as they have brought their own liquid to move about in. This method is called INTERNAL FERTILIZATION.

The advantage of internal fertilization is that fewer sperms are needed. Why? Because they do not have so far to swim! They are also not in danger of getting swept away in the water or eaten!

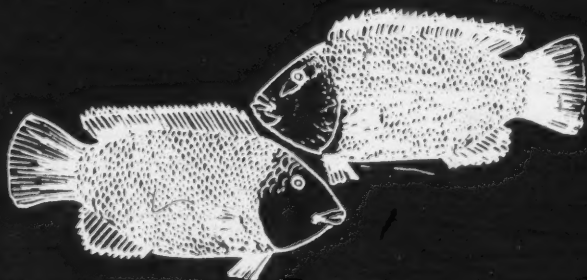
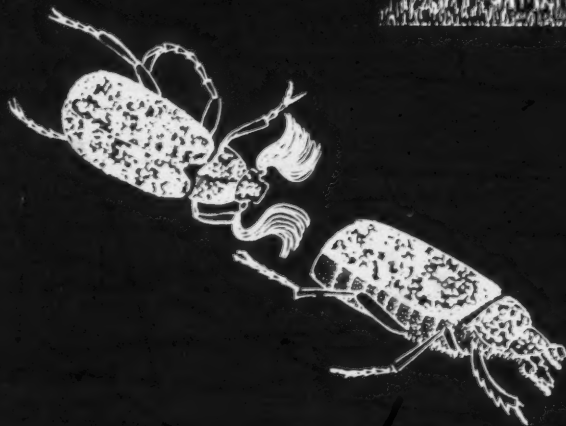
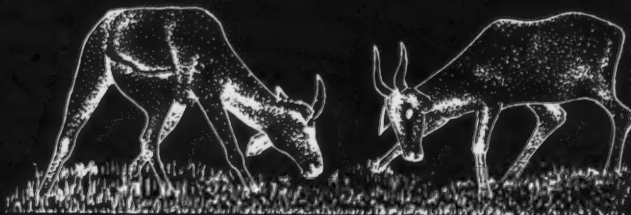
Have you ever seen two insects joined together like those in the diagrams? Look around you on your way home and if you see any examples, discuss them with the class in the next lesson.

GETTING TOGETHER

Have you noticed that in all the cases of fertilization you have read about, the male and female have got together to produce eggs and sperms? You know that this was in order to give the eggs a greater chance of being fertilized. Also fewer sperms need to be produced. This getting together is called MATING. We shall be looking at the different ways in which animals attract each other to mate.



Look at the pictures of MATING
ACTIVITIES of some animals. Your teacher will describe
them to you. Listen carefully as you will be required
to answer questions in Exercise 8 afterwards.

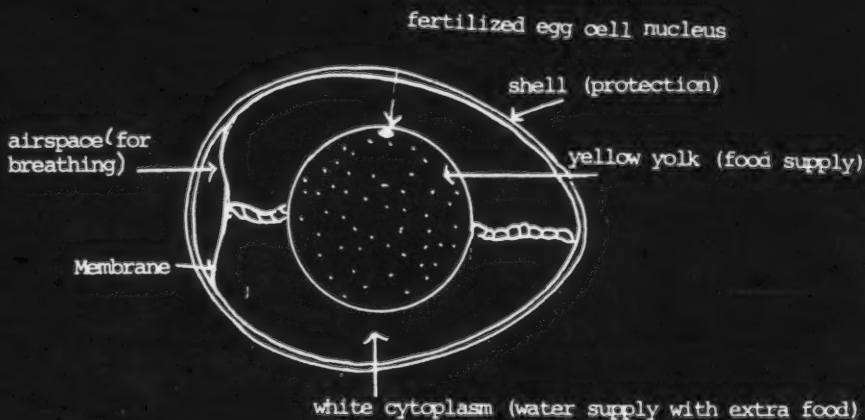


Can you think of any other mating activities you may have seen on the farm or in the bush which you can discuss with the class?

After mating, the egg cell is fertilized. It is now able to start growing.

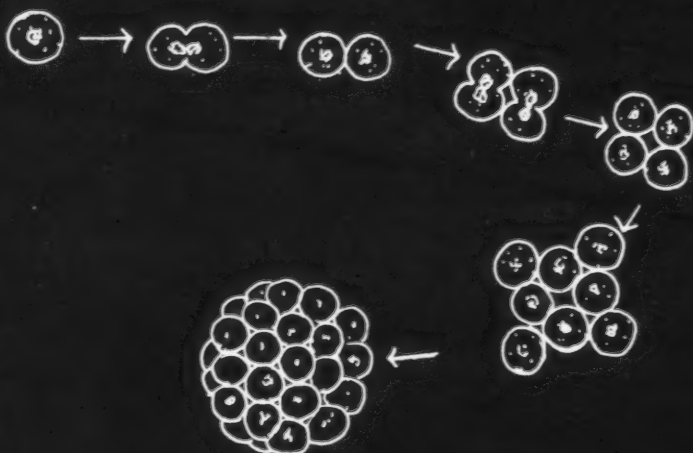
WHAT HAPPENS TO THE FERTILIZED EGG CELL?

Many animals make eggs which can grow into a new organism outside the body of the female. The fertilized egg cell is given a separate food supply which it uses to grow. You are now going to study an example of such an egg. It is one you know well - a hen's egg!



WHAT HAPPENS TO THE FERTILIZED CELL?

When conditions are right, the fertilized egg cell starts to divide into two cells. Each new cell has a full set of instructions in the nucleus which comes from two parents. The cells divide in the ordinary way of growing which you saw on the biostrip (slide 8). Look at the diagram below. The fertilized cell divides into two. These two cells become four, the four cells divide into eight and so on, until a ball of cells is formed.



Each cell has copied the information in the nucleus of the cell from which it was formed, so it has a full set of instructions each time. As soon as it divides, the one cell becomes an EMBRYO. Embryo is the name given to a new organism from the time the fertilized cell starts to grow until the organs have developed enough for it to live by itself.

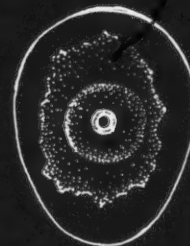


I'm sure you have wondered what goes on inside a hen's egg. If you break open an egg just after a hen has laid it, you will find a yellow yolk, and white cytoplasm around it. If a hen keeps an egg warm for three weeks there is a chicken there instead!

Now you will see for yourself what goes on inside the shell.

LOOKING AT A FERTILIZED EGG GROWING INTO A NEW ORGANISM

If you cut a hole in the top of a fertilized hen's egg, and stuck a small piece of clear plastic or glass over it, you would have a window through which to watch a chicken develop. You would have to keep it as warm as a mother hen would, because it will only grow when it is at the right temperature.



The slides on Biostrip JG 'How animals reproduce' show what you would see if you watched through that window with a microscope.



Now look at the Bioaset slides 3-8 and read about them in the bioaset. Your teacher will discuss them with you.

SUMMARY

You have seen the cells grow and divide into first two and then four, all by normal growing cell division. At first the cells all appear the same and after a few divisions they form a ball of cells. In a very short time there are hundreds of cells.

As the embryo gets bigger cells need to do different jobs and so they start to specialize. Organs begin to develop. The backbone or spine forms and one end of it gets bigger.



This will become the head. Around the edges of the embryo tubes grow out into the yolk to bring food. A heart develops. It is very small, but if it were a live chicken you would be able to see it as a tiny red dot.

Within 7 days small buds appear which will become legs and two wings and an eye has started to grow. Now you can see that it will be a baby bird.

The last slide is life sized and shows an embryo one week old. The embryo grows inside a bag of liquid which protects it from injury.

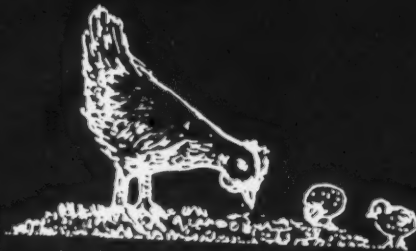
The diagram below shows a chick embryo two weeks old. It looks even more like a bird now. Can you see the tubes which bring food from the yolk into the front of the chicken? You will remember that air can diffuse into the egg through the pores (tiny holes) in the shell and the membrane.



At three weeks the chicken would be ready to hatch. Baby chickens have a tiny 'tooth' on their beaks which enables them to crack their egg shells and come out of the egg. When they hatch they are very small but able to walk about and feed themselves.



You will of course have seen how the mother hen helps them to find food and protects them from danger.



Egg Sizes

Here are some pictures of the eggs of some animals which come from different tribes. The animals are of similar size, now compare the sizes of their eggs.

gold fish egg



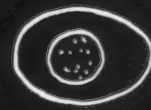
frog's egg



chameleon's egg



dove's egg

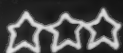


rat's egg

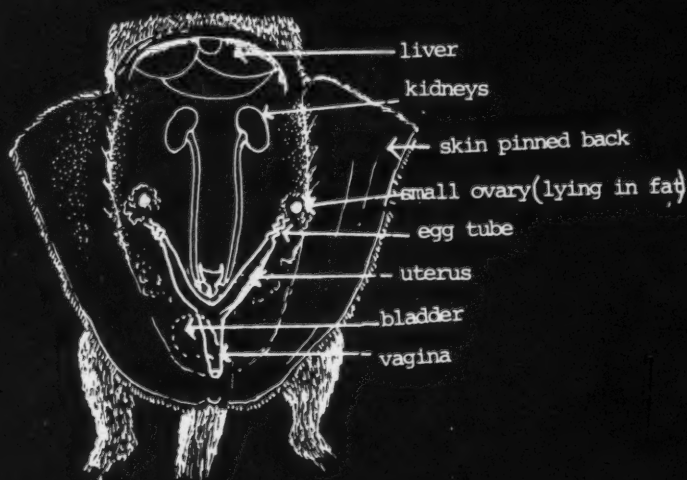


You have learned how a chicken embryo grows using the food supply within the egg and is kept warm by the hen.

Why do you think a rat's egg is so small? In female mammals which have live young such as the rat, there is another organ which holds the developing embryo. It provides it with food and warmth until it is born alive. So the egg itself does not need its own separate food supply.



Look at the diagram of the reproductive organs of a female rat and you will see this special organ. It is called a UTERUS - you may have heard it called the womb. Below the uterus is the VAGINA, a muscular tube where the sperms are placed.

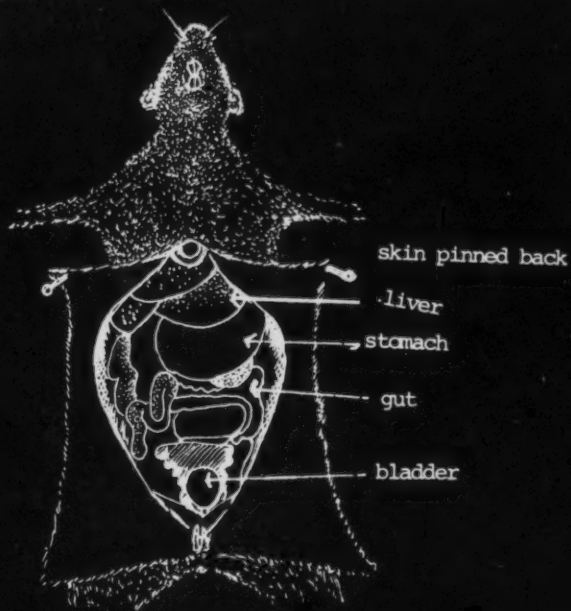


You will see the two round OVARIES which produce the egg cells. From here they pass into the egg tubes, where they wait to be fertilized if mating takes place. They then move into the uterus. If they are fertilized, a special organ grows joining each embryo to the wall of the uterus.

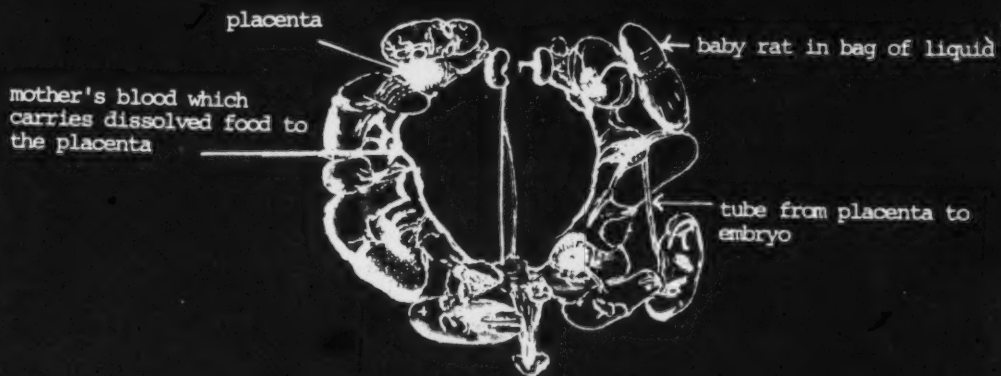
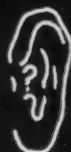


This special organ is called a PLACENTA. It is quite a large organ inside which dissolved food and air pass from the blood of the mother to the blood of the embryo by diffusion. The embryo grows until it can breathe for itself and take in food by mouth. Then it is ready to be born. The muscular walls of the uterus push the new animal out into the world.

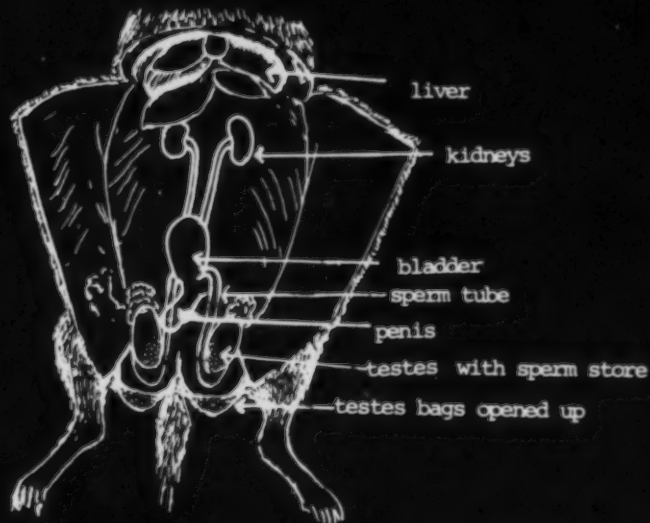
A rat which
has just been
opened up showing
some organs.



Your teacher will try to get a fresh rat to cut up to show you the reproductive or sex organs in a real animal. You will also get the chance to look at other organs such as lungs and heart. Your teacher will point them out to you. Your rat may be male or female. You may be lucky enough to find baby rats or embryos developing inside the uterus if your rat is a female. Take a good note of how they are attached to the mother. You should see that there is a placenta. Each embryo is contained in its own protective bag of liquid. Count how many embryos are found.



If, however, your rat is a male it will look like this.
Look at the diagram, it is of the male reproductive organs
of a rat.

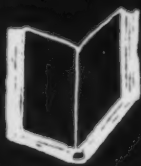


The male sex organs are low down in the body of the animal.
There are two round organs which produce the sperm called
the TESTES. They often lie out of the body in a little
bag. (You may have noticed these in dogs or bulls.)

The sperms pass into tubes on the testes where they are
stored in a sperm store until mating takes place. Then
they are pushed out through a special male organ (PENIS)
into the body of the female.

When the rat has been dissected, look back at your diagrams
of the sex organs and check that you have seen all the
parts and can understand the diagrams.

Now that you have completed Part 2 of this Unit, read it
again. Spend a whole lesson on revision and then answer
'How much do you know?'



HOW MUCH DO YOU KNOW?

1. Sex cells contain only a _____ set of _____ in the nucleus.
2. Male sex cells are called _____ and are produced by an organ called the _____.
3. Female sex cells are called _____ or _____ and are produced by an organ called the _____.
4. When the male and female sex cells fuse the egg is said to be _____.
5. When the sex cells fuse outside the body of the female this is called _____.
Examples of animals which do this are _____ and _____.
6. When the sex cells fuse inside the body of the female this is called _____. Examples of animals which do this are _____, _____ and _____.
7. A developing organism is called an _____ until it can live by itself.
8. Most animals lay eggs which contain a _____ which the developing animal uses to grow.
9. A rat egg grows inside a special organ called a _____. It obtains its food from the mother through another special organ called a _____.
10. Baby birds and rats grow inside a bag of _____. They are joined to their food supply by _____.
11. A male rat has a special organ which fits into the female called a _____.

?

PART 3WHAT HAPPENS IN HUMANS?

In the human, egg cells are produced in a similar way. The ovaries produce one tiny egg cell each month. This passes into the egg tube or OVIDUCT and stays there for a few days. Meanwhile the skin lining the uterus (or womb) becomes rich with blood and tissue, ready to supply food and air to the egg if it becomes fertilized.



Below the uterus is the VAGINA - a muscular tube where the sperms are placed. The sperms swim up through the uterus into the tubes where one sperm will fertilize the egg. The fertilized egg moves into the uterus (or womb) where it attaches itself to the lining and starts to grow.



If mating does NOT take place the egg cell passes out. Then the special tissues lining the uterus are cleared away. This is the blood flow out of a woman's body each month. We normally call this 'having a period' (MENSTRUATION) and it happens two weeks after the egg cell is released from the ovary. The blood seen is not the egg. After this the uterus starts to grow a new lining in preparation for the next egg.

A HUMAN BEGINNING AND GROWING

A human embryo begins in the same way as a chicken - from a sperm and an egg cell or ovum. After fusion, the fertilized cell starts to divide into two, four then eight until a ball of cells is formed. The egg cell has some cytoplasm food around it (you will remember that it is bigger than the sperm cell). This lasts until it is joined to the uterus and can get food from the mother. After many cells have been made, they start to specialize. As the spine thickens at the top to form the head it still looks similar to a chick embryo, then organs start to appear. See Picture 1.

ALL THE PICTURES OF EMBRYOS WHICH FOLLOW ARE REAL LIFE SIZE



Picture 1

7 week old embryo (life size)

When an organ starts to develop it is very simple. Where there is a heart or an eye, it is not completed for some time. The tiny gut is only being made and cannot do any work until the embryo is ready to be born. It is like building a house. The walls may be seen to be half built, but are not used until they are finished.



Picture 2

3 month old embryo (life size)

Look at the second picture. It is an embryo about three months after it has started to grow. It looks like a human baby now. You can see that it is growing within a bag of protective liquid - like that of the chicken and the rat.

Even in an embryo this size you can see the head clearly, and where the eye and ear are growing. Tiny blobs will grow into fingers and toes on the end of little arms and legs. Observe that the head is almost as big as the body!

Picture 3

6 monthold embryo (life size)

Placenta



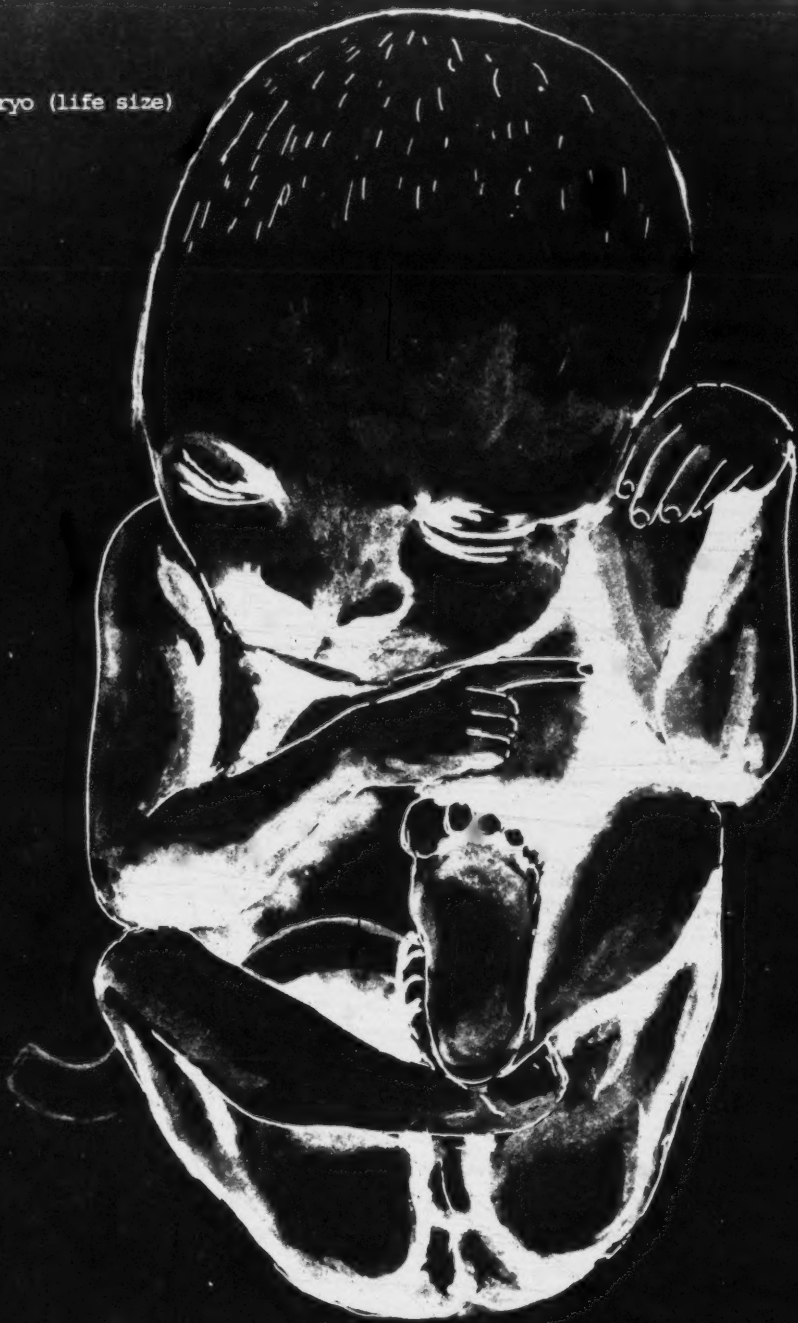
In this next picture the baby is drawn without its bag of liquid. This is the size of an embryo about six months after fertilization. Can you see the tube which joins it to the placenta? The placenta has grown large and is almost the same size as the embryo. Why do you think the placenta increases in size whereas a yolk in a hen's egg gets smaller?

Muscles are developing on the legs and arms. From when an embryo is four months old these muscles are able to move and the legs can kick about inside the uterus. The mother can then feel the embryo moving.

Picture 4

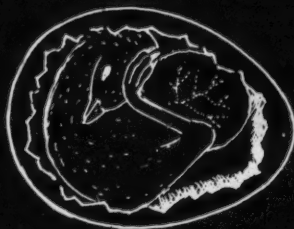
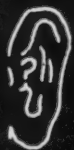
8 month old embryo (life size)

38



The fourth picture is of an embryo when it is eight months old. Hair is starting to grow, it is fatter and even fingernails can be seen. It is well developed now.

Small diagrams of
chick and human baby
for you to compare



After nine months the uterus starts to squeeze and the mother knows that the baby is ready to be born. The bag of liquid breaks and the baby starts moving head first out of the body of the mother. The vagina stretches and the strong muscles of the uterus push the baby out into the world. It cries and starts to breathe. It has needed food and air during birth which may take several hours, so has stayed attached to the placenta. Once it breathes for itself the baby no longer needs the placenta, so the tube must be tied and cut. This must be done with clean string and a razor blade which have both been boiled to kill germs. Any dirt or germs could easily pass up the tube and straight into the baby's blood, making it very ill.

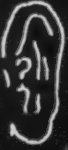
The baby can now live on its own as its organs are well developed. The lungs breathe air and the gut can take in food.

A baby mammal's first food is milk. It gets milk from its mother. All mammals make milk which is exactly right for their baby to grow properly. This is why cow's milk is not the same as goat's milk or rat's milk!

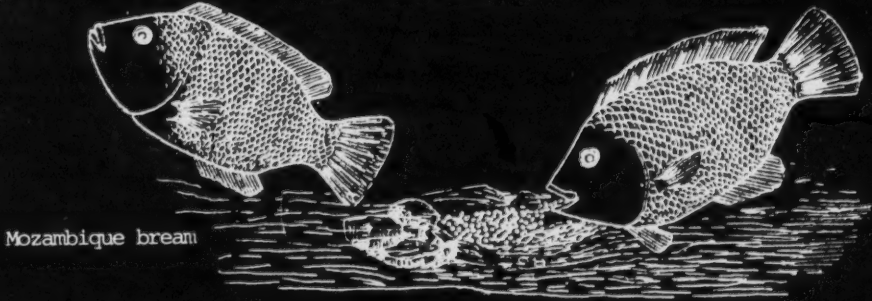
The best milk for a human baby comes from a human mother. Milk from a cow or goat is not quite right for a new born baby.

You know that a mother also cares for her baby. Do other animals do this too?

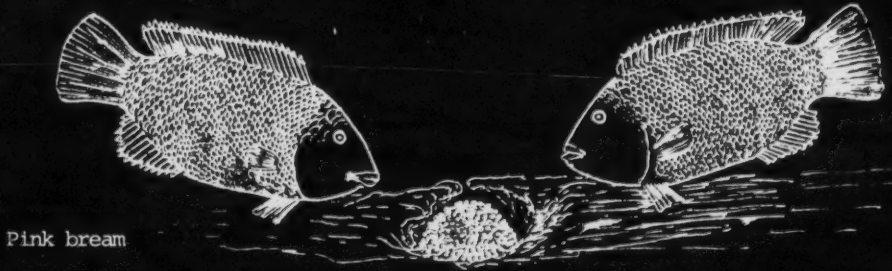
LOOKING AFTER THE YOUNG



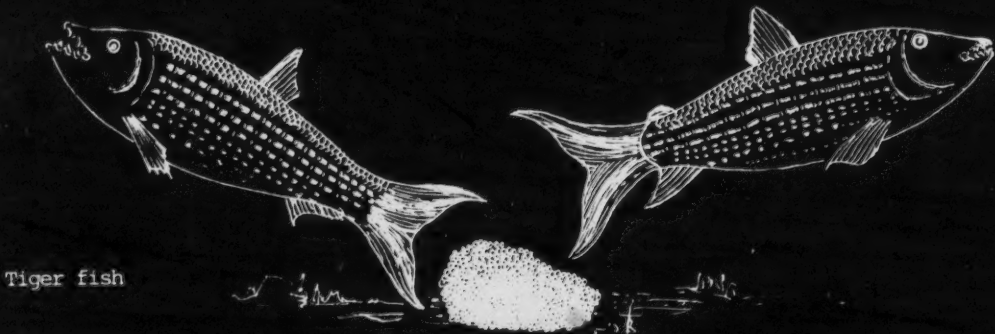
Have you wondered why some animals produce lots of eggs, others only a few? Your teacher will give you some clues as to why some animals need to produce more eggs than others. Listen to your teacher now.



Mozambique bream



Pink bream



Tiger fish

You will understand that the Pink Bream lays more eggs than the Mozambique Bream. The Tiger Fish lays far more eggs than either kind of bream. Why is this so? Answer Exercise 9.



Now we have seen how some fish care for their young after birth, let us see what other animals do.

There are three important things which developing animals need. These are:

1. warmth
2. protection
3. food supply after birth (hatching)

Providing these things is called PARENTAL CARE. Look at the chart. Can you see a pattern in the number of young and the care they get? Is it the same as for the bream?

CARE OF YOUNG				
ANIMAL	Warmth	Protection	Care after birth	Number of young
Fish	None	Very little	None	thousands
Amphibia	None	Very little	None	hundreds
Reptiles	Leave eggs in warm place	Rare	None	hundreds
Birds	Eggs & young warmed by body	Guard nest	Feeding	up to 30
Mammals	Body warmth	Protection with mother	Milk & loving care	1 - 20

Discuss this with your teacher.

The more care given to the embryo and young by the parents the fewer need to be produced for an animal to replace itself. This is because with PARENTAL CARE an embryo has a very much better chance of survival.

Of course, animals cannot guard against everything. Weaker animals, such as rabbits and rats, need to produce more young than lions and elephants! In humans, sickness used to result in many babies dying and a man and woman had to have many children so that a few might survive to look after them in their old age.

Over the past few hundred years people have learnt about cleanliness helping to prevent some diseases and modern medicines have helped cure many. This means that children have a good chance of surviving these days.

All people want to give their children the best chance of survival. They can learn how to care for children at the special clinics all over the country. These clinics teach the mother:

1. How to look after herself so that the baby is born strong.
2. What to do to prevent herself and the baby getting diseases when the baby is born.
3. How to prevent measles and many other illnesses.
4. The best way to feed a young child.

Women should start to attend these clinics at least three months before they expect the baby to be born. This way fewer babies will die. Do you think then that people will need to have fewer children? Discuss this with your teacher.

Now that you have finished the Unit, spend a lesson on revision of Part 3. Then read the summary that follows.

Afterwards you should re-read the whole Unit and you will see that all the AIMS of the Unit are now satisfied.

SUMMARY

1. A cell is the smallest unit of a living organism.
2. A cell has cytoplasm and a controlling nucleus inside a membrane.
3. Plant cells also have a cell wall and vacuoles with liquid cell sap inside them.
4. Some small organisms consist of one cell but most organisms are built up of many cells.
5. Many celled organisms have specialized cells which do different work.
6. These specialized cells are grouped into tissues.

7. Organs are made up of tissues of cells and each have a certain job to do in keeping the organism alive.
8. Organisms increase their size when cells divide up into more cells which are exactly the same.
9. Some simple organisms can reproduce by splitting but most reproduce sexually.
10. Sexual reproduction needs two specialized sex cells.
11. Each sex cell contains only a half set of information in its nucleus.
12. Fertilization is when the male and female sex cells fuse together to give a new cell.
13. In animals the male sex cells are called sperms and are made in testes.
14. The female sex cell is an ovum or egg cell and is made in an ovary.
15. Fertilization is external in animals which live in water, internal in land animals. Mating activities bring male and female animals together.
16. A developing organism is called an embryo. Provision for its growth is made in the form of protection and food.
17. In most kinds of animals eggs are laid. In mammals the embryo develops inside the mother's body.
18. In mammals internal fertilization takes place inside the female. The ovary makes an egg cell which passes down the egg tube. During mating the sperm cells are placed in the VAGINA by the male's PENIS. They swim up through the UTERUS to the egg tube where one will fertilize an egg cell. The egg moves into the uterus and attaches itself to the wall. A placenta grows to supply the embryo with food. The embryo develops inside a bag of liquid which protects it.
19. When the embryo is able to live on its own it is born and fed on milk for some time.
20. The more care given to the young by the parents, the greater the chance of survival of each new organism. Therefore, the greater the parental care, the fewer young need to be produced.